HUC 07140101 – Cahokia-Joachim Subbasin
Water bodies: 1709
Pollutant(s): Pathogens as indicated by *Escherichia coli*

WATER PROTECTION PROGRAM

Total Maximum Daily Load
Implementation Plan

for

Maline Creek
St. Louis County and St. Louis City

Pollutants of concern: Pathogens

Completed: May 2, 2017

SUMMARY of IMPAIRED WATER BODIES

Maline Creek Total Maximum Daily Load (TMDL) Implementation Plan
Pollutant(s): Pathogens as indicated by *E. coli*


State Map Showing Location of Watershed

Name: Maline Creek
Location: St. Louis County and St. Louis City

12-digit Hydrologic Unit Code (HUC) and Name:[1]
071401010401 – Maline Creek-Mississippi River

Water Body Identification Number and Hydrologic Class:[2]
Water body ID No. 1709 – Class C

Designated uses:[3]
Livestock and wildlife protection
Irrigation
Protection and propagation of fish, shellfish and wildlife – warm water habitat
Human health protection
Secondary contact recreation
Whole body contact recreation category B

Uses that are Impaired:
Whole body contact recreation category B

Length and locations of impaired segments:
WBID 1709 0.97 km (0.6 mi), from Sur 3125,46N,7E to 9,46N,7E (Land grant 00003)

Universal Transverse Mercator [Zone 15 north] coordinates:
WBID 1709 From E: 741487, N: 4290493 to E: 741068, N: 4291197

Pollutant on 2016 303(d) List:
Escherichia coli, or *E. coli*, bacteria as an indicator for pathogens

[1] The hydrologic unit code, or HUC, system is a way to classify watersheds by size. This is a national system used to communicate the size and relationship of watersheds. Every hydrologic unit is identified by a unique HUC, a number containing two to 12 digits. The more digits the HUC number contains, the smaller the watershed.
[2] For hydrologic classes see 10 CSR 20-7.031(1)(F). Class C streams may cease flow during dry periods, but maintain permanent pools that support aquatic life.
[3] For designated uses see 10 CSR 20-7.031(1)(C) and 10 CSR 20-7.031 Table H. Presumed uses are assigned per 10 CSR 20-7.031(2)(A) and (B) and are reflected in the Missouri Use Designation Dataset described at 10 CSR 20-7.031(2)(E).

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Maline Creek at Bellefontaine Road
(Left – low flow conditions in 2006. Right – stormwater conditions in 2015)

1 – Introduction

A total maximum daily load, or TMDL, identifies water quality problems, possible causes of those problems, and provides targets for restoration. Real water quality improvements, however, are often dependent upon actions and support from local communities and landowners residing within the watershed. This document is a supplemental planning document to aid in the implementation of activities in the Maline Creek watershed that will address the goals established in the Maline Creek *E. coli* TMDL. Although separate, this implementation plan should be considered a companion to the TMDL. The purpose of this implementation plan is to serve as a general guide to permit writers, nonpoint source program coordinators, and other department staff, as well as Soil and Water Conservation districts, local governments, permitted entities, regional planning commissions, watershed managers, and citizen groups for achieving the wasteload and load allocations established in the TMDL. The *E. coli* TMDL report for Maline Creek is available on the department's website at dnr.mo.gov/env/wpp/tmdl/1709-3839-maline-cr-record.htm. Questions regarding the TMDL may be sent via email to tmdl@dnr.mo.gov or by calling the department's Watershed Protection Section at 573-751-5723.

The department recognizes that technical guidance and support are critical to achieving the goals of the TMDL. While the TMDL establishes the maximum bacteria loading that Maline Creek can assimilate and still meet water quality standards, this implementation plan provides additional information regarding best management practices, potential participants in the watershed, and calculations of pollutant reductions in order to guide implementation activities that will eventually restore attainment of water quality standards. This plan is not intended to prescribe or prohibit any specific practices or technologies to reduce bacteria loading in the Maline Creek watershed. Nor is it intended to serve as the sole means of remediation and restoration of impaired water bodies in the watershed. Any existing or planned Section 319 9-element watershed-based plans that address regions or subwatersheds within the Maline Creek watershed should be updated to incorporate the goals and strategies outlined in this plan. Any such plans or other known management practices already in place that will aid in meeting the goals established in the TMDL are referenced in this plan in order to facilitate those efforts without duplicating the work.

Because the TMDL addresses bacteria loading from all potential sources in the watershed, this implementation plan provides guidance for meeting the established loading targets assigned to both point and nonpoint sources.[4] Point sources of pollution are regulated through the Clean Water Act. Any reductions in bacteria loading from these sources will primarily be completed through the Missouri State Operating Permit program along with any other enforcement or legal actions administered for compliance with this law (See Section 6.1). Nonpoint sources of pollution are not regulated through permits and any reductions from these sources will rely on the voluntary implementation of best management practices, or BMPs, in the watershed (See Section 6.2).

The location of the impaired water body segment addressed by the Maline Creek *E. coli* TMDL is presented on the next page in Figure 1.

[4] Point and nonpoint sources are defined and discussed in Sections 5.1 and 5.2 of the Gravois Creek *E. coli* TMDL.

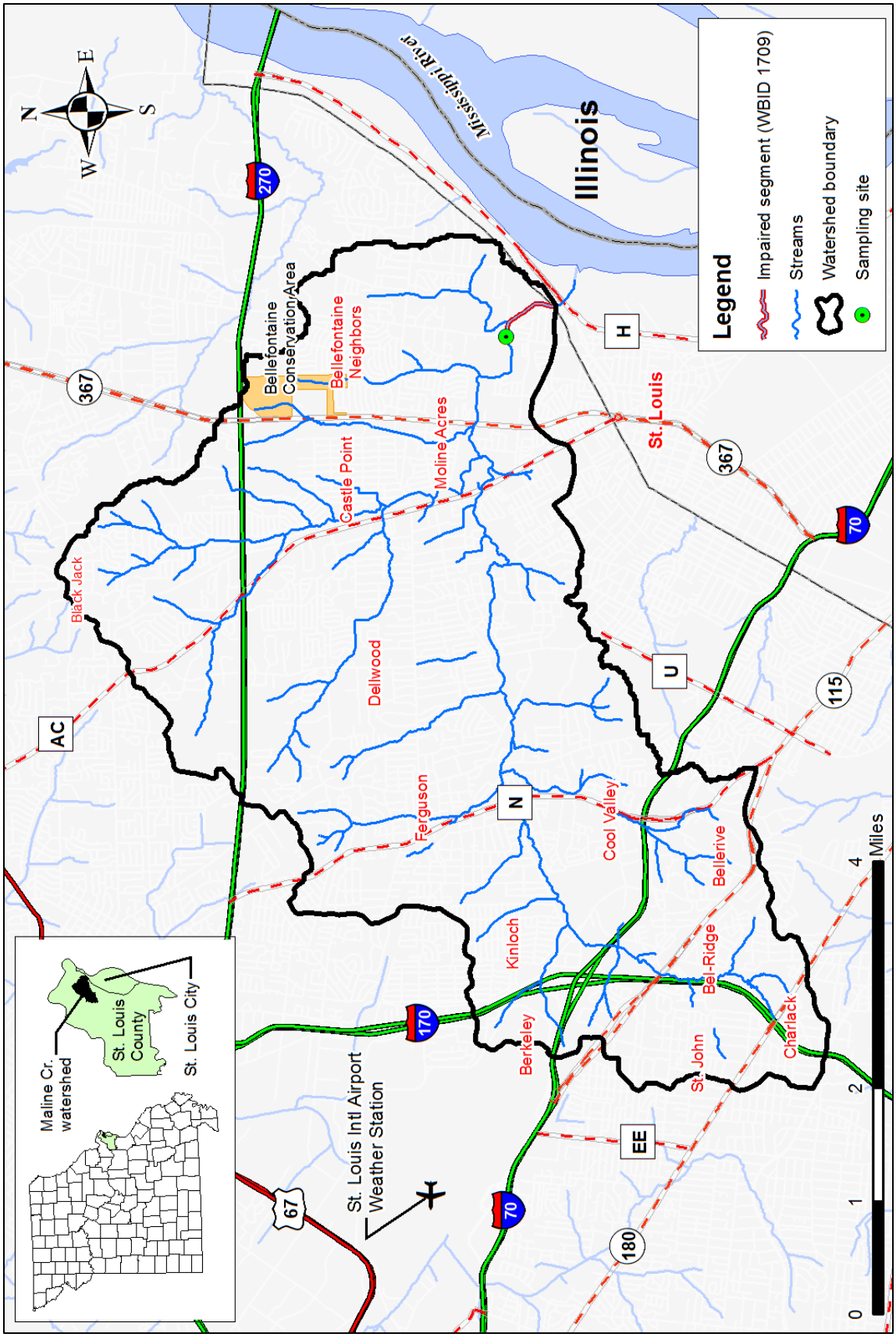

Figure 1. Map of the Maline Creek watershed

2 – Targeted Participants and Potential Roles in Implementation

TMDL implementation is carried out in part by the department through the Missouri State Operating Permit program for point sources and for nonpoint sources through projects and cost-share practices funded in part by grants or subgrants from the department's Section 319 Nonpoint Source Implementation Program and the Soil and Water Conservation Program. Additional implementation can be completed through actions taken by local governments, citizen groups, and others with an interest in improving water quality in their communities. Successfully meeting the goals of the TMDL will require participation and cooperation from the various parties within the watershed with roles ranging from technical support to actual on-the-ground implementation of BMPs. Groups and agencies that may potentially be involved in the TMDL implementation process are identified below along with descriptions of their possible roles. This list is not exhaustive and is not intended to compel participation from any organization; nor is it meant to exclude those who are not listed, but may be interested in participating.

- Department of Natural Resources
  - Administer statutory authorities granted by Missouri clean water law
  - Ensure permits issued in the watershed are consistent with the assumptions and requirements of TMDL wasteload allocations per federal regulations
  - Provide compliance assistance, inspections, and enforcement actions to regulated entities as appropriate
  - Provide technical support to watershed groups as appropriate
  - Serve as a potential source of financial assistance for watershed plan development or BMP implementation through Section 319, 604(b) grants, or Soil and Water Program cost-share practices
  - Serve as a potential source of financial assistance for infrastructure improvements through low-interest State Revolving Fund loans
  - Assess compliance with water quality standards on a biennial basis in accordance with Sections 303(d) and 305(b) of the Clean Water Act
  - Coordination of watershed planning efforts and promotion of stakeholder involvement
- Metropolitan St. Louis Sewer District
  - Implement activities as described and scheduled in consent decree[5]
  - Reduce sanitary sewer overflows as described and scheduled in consent decree
  - Implement MS4 permit terms and conditions pertaining to discharges to TMDL waters
  - Continued implementation of the six minimum control measures to effectively reduce pollutants to the maximum extent practicable, or MEP, to the MS4
- MS4 co-permittees located in the Maline Creek watershed
  - Implement MS4 permit terms and conditions pertaining to discharges to TMDL waters
  - Continued implementation of the six minimum control measures to effectively reduce pollutants to the maximum extent practicable, or MEP, to the MS4

[5] A consent decree was established as part of the *United States of America and the State of Missouri, and Missouri Coalition for the Environment Foundation v. Metropolitan St. Louis Sewer District*, No. 4:07-CV-1120. The consent decree and its appendices are available online at epa.gov/region07/enforcement_compliance/MSD_consent_decree_cwa.htm.

- Missouri Department of Transportation
  - Implement MS4 permit terms and conditions pertaining to discharges to TMDL waters
  - Continued implementation of the six minimum control measures to effectively reduce pollutants to the MEP to the MS4
- County Soil and Water Conservation District
  - Provide financial incentives to urban agricultural producers for the implementation of conservation practices that help prevent soil erosion
  - Provide technical assistance with design, implementation and maintenance of conservation practices
- University of Missouri Extension
  - Technical assistance with nonpoint source and watershed management issues
  - Assistance in organizing locally led watershed groups
- Missouri Department of Conservation
  - Technical assistance with stream and watershed management issues
  - Promote maintenance and reestablishment of functional riparian corridors
- Missouri Department of Health and Senior Services
  - Technical assistance and regulatory authority regarding onsite wastewater treatment systems
- County health department
  - Technical assistance and regulatory authority regarding local ordinances
- Locally led watershed groups
  - May apply for Section 319 subgrants
  - Help identify critical areas at a local level
  - Voluntary implementation of BMPs
  - Public education and outreach
- Stream Team volunteers[6]
  - Volunteer Water Quality Monitoring program - *E. coli* monitoring may be conducted at the Cooperative Stream Investigation level[7]
  - Stewardship (e.g., litter pick up and storm drain stenciling)
  - Advocacy
  - Education
- General public within the Maline Creek watershed
  - Voluntary lifestyle changes (e.g., pet waste cleanup, septic system maintenance, water conservation, erosion control practices, etc.)
  - Voluntary implementation of BMPs on private lands, residences and businesses

[6] The Missouri Stream Team Program is a partnership between the Department of Natural Resources, the Department of Conservation, the Conservation Federation of Missouri, and the citizens of Missouri. The Stream Team Program provides an opportunity for all citizens to get involved in river conservation. Additional information regarding the Stream Team program is available online at mostreamteam.org.

[7] More information regarding the Volunteer Water Quality Monitoring, or VWQM, program is available online at dnr.mo.gov/env/wpp/VWQM.htm. Cooperative Stream Investigation, or CSI, level monitoring uses EPA approved and accepted analytical methods as well as standard analytical methods developed for the VWQM program. More information regarding the CSI level of training is available on the department's website at dnr.mo.gov/env/esp/csi.htm.

3 – Why is a TMDL Needed for Maline Creek?

Section 303(d) of the federal Clean Water Act and Chapter 40 of the Code of Federal Regulations Part 130 requires states to develop TMDLs for waters not meeting applicable water quality standards. Missouri's Water Quality Standards consist of three major components: designated uses, water quality criteria to protect those uses and an antidegradation policy. Descriptions of each of these components can be found in Section 3 of the TMDL. Maline Creek is not attaining designated recreational uses due to exceedances of Missouri's numeric criteria for *E. coli* bacteria. High counts of *E. coli* are an indication of fecal contamination and an increased risk of pathogen induced illness. A summary of the available *E. coli* data for Maline Creek is presented in Table 4 of the TMDL report. The department determines a water to be impaired by pathogens if the *E. coli* criteria are exceeded in any of the last three years for which there is a minimum of five samples taken during the recreational season. Missouri's recreational season is defined in rule as being from April 1 to October 31. Table 1 below presents the recreational uses assigned to Maline Creek.

Table 1. Designated recreational uses of Maline Creek

Stream Name	***Water body ID no.***	***Designated Recreational Uses****
Maline Creek	1709	WBC-B, SCR

* WBC-B = whole body contact recreation category B
SCR = secondary contact recreation

Designated uses for water bodies in Missouri are identified in the state's Water Quality Standards at 10 CSR 20-7.031. The Clean Water Act at Section 101(a)(2) requires that wherever attainable, waters be designated with uses that provide for recreation in and on the water. Missouri's Water Quality Standards include three recreational uses. These uses include whole body contact recreation category A, whole body contact recreation category B, and secondary contact recreation. Whole body contact recreation includes activities in which there is direct human contact with surface water that results in complete body submergence, thereby allowing accidental ingestion of the water as well as direct contact to sensitive body organs, such as the eyes, ears and nose. Category A waters include water bodies that have been established as public swimming areas and waters with documented existing whole body contact recreational uses by the public (10 CSR 20-7.031(1)(C)2.A.(I)). Category B applies to waters designated for whole body contact recreation, but are not contained within category A (10 CSR 20-7.031(1)(C)2.A.(II)). Secondary contact recreation includes activities in which there is limited, incidental or accidental contact with the water and the probability of ingesting appreciable quantities of water is minimal. Such activities include boating, fishing and wading (10 CSR 20-7.031(1)(C)2.B.).

4 – Review of Sources of Bacteria Loading in the Maline Creek Watershed

Section 5 of the Maline Creek *E. coli* TMDL contains a comprehensive inventory and assessment of all known and suspected sources of bacteria in the watershed. This implementation plan presents a summary of those sources. Sources of bacteria are categorized in the TMDL as being either regulated point sources or unregulated nonpoint sources.

The bacteria sources identified in the TMDL are based on issued permits and general knowledge of watershed conditions. For some sources, specific loading contributions remain unknown. Groups interested in implementing practices in the subwatersheds of Maline Creek may want to consider employing microbial source tracking techniques to better identify the primary sources of *E. coli* in their area (i.e., poultry, equine, cattle, domestic pets, wildlife and humans). However, such techniques can be cost prohibitive and may be unnecessary if localized land use conditions are already well known. More information regarding microbial source tracking techniques is available online from the U.S. Geological Survey at water.usgs.gov/owq/microbial.html.

4.1 - Point Sources

Point sources are typically regulated through the Missouri State Operating Permit program, which is Missouri's program for administering the federal National Pollutant Discharge Elimination System, or NPDES, program. The NPDES program requires all point sources that discharge pollutants to waters of the United States to obtain a permit. Activities in the Maline Creek watershed that are regulated by a permit that have a potential to contribute significant bacteria loads are stormwater discharges from municipal separate storm sewer system. In addition to these permitted discharges, other unpermitted point sources with a potential to contribute bacteria loads in the Maline Creek watershed include sanitary sewer overflows and illegal straight pipe discharges of domestic wastewater.

4.1.1 - Municipal Separate Storm Sewer System (MS4) Discharges

Municipal separate storm sewer systems, or MS4s, collect stormwater runoff from urban areas and discharge this water directly into streams with little or no treatment. Urban stormwater can contain wastes from both pets and wildlife, as well as contaminated water from failing onsite wastewater treatment systems (i.e., septic tanks) and sanitary sewer overflows. Typically, MS4 discharges are untreated, but BMPs may be used to reduce contamination or the overall amounts of stormwater entering the system. Because MS4 discharges are precipitation dependent, bacteria loading is likely to increase under wetter conditions when runoff is more likely. Therefore, the wasteload allocations assigned to MS4s vary with flow. Included in the aggregated wasteload allocation for the Maline Creek *E. coli* TMDL are pollutant loads from the Metropolitan St. Louis Sewer District and its co-permittees, as well as infrequent and minor inputs from Missouri Department of Transportation highway corridors. Affected co-permittees of the sewer district are St. Louis County and the municipalities of Bel-Nor, Bel-Ridge, the sewer district include Bellefontaine Neighbors, Berkeley, Black Jack, Calverton Park, Charlack, Cool Valley, Dellwood, Ferguson, Florissant, Hazelwood, Jennings, Moline Acres, Normandy, Riverview and St. John.

4.1.2 – Sanitary Sewer Overflows

Sanitary sewer overflows are unpermitted discharges that are not authorized by the Clean Water Act, but can contribute bacteria loads to streams in the Maline Creek watershed. Sanitary sewer overflows are discharges from a separate sanitary sewer system such as overflows from

manholes, pipe breaks, or backups into private residences. Sanitary sewer overflows can occur under dry weather conditions due to power failures, line breaks, or blockages, or can occur under wet weather conditions if the sewer system becomes overwhelmed by excess stormwater infiltrating the sewers. Sanitary sewer overflows are assigned a wasteload allocation of zero and no portion of the loading capacity is assigned to these sources. In the Maline Creek watershed, constructed sanitary sewer overflows designed to relieve the sewer system during heavy rainstorms are also present. These constructed overflows are also unauthorized by the Clean Water Act and are assigned a wasteload allocation of zero indicating a need to completely eliminate these sources.

4.1.3 - Illicit (Illegal) Straight-Pipe Discharges

Illicit straight-pipe discharges of domestic wastewater are another potential point source of bacteria. These types of sewage discharges bypass treatment systems, such as a septic tank or a sanitary sewer, and instead discharge directly to a stream or an adjacent land area (Brown et al. 2004). Straight-pipe discharges are illegal and are not permitted under the Clean Water Act. Due to the illegal nature of these discharges, any illicit straight-pipe discharges must be eliminated. The detection and elimination of illicit discharges is a required permit condition for MS4s. Since there is no legally allowable discharge from these sources, the TMDL does not allocate a portion of the loading capacity to straight-pipe discharges and they are assigned a wasteload allocation of zero.

4.1.4 – Future Point Sources (New Permitted Facilities)

No specific portion of the loading capacity is allocated to a reserve capacity for new dischargers. Due to the urban nature of the watershed and the presence of sewerage systems throughout the watershed, the likelihood of new facilities having a significant potential to contribute bacteria loads to Maline Creek is low. Even so, the wasteload allocations presented in the Maline Creek TMDL report do not preclude the establishment of future point sources in the watershed. Future point sources should be evaluated against the TMDL and the range of flows, which any additional bacterial loading will affect, as well as any additional requirements associated with anti-degradation. Such an evaluation may be necessary when applying for a permit as a new discharger. Future general and stormwater permitted activities that are not associated with domestic wastewater or animal feeding operations are not expected to actively generate bacteria and compliance with all permit conditions is assumed to result in loading at *de minimis* levels that will not exceed the available wasteload allocations. All application procedures for new dischargers must be followed. Such information is available online on the department's website at dnr.mo.gov/env/wpp/permits/ww-construction-permitting.htm or by calling the department at 573-751-1599.

4.2 - Nonpoint Sources

Nonpoint source pollution refers to pollution coming from diffuse, non-permitted sources that typically cannot be identified as entering a water body at a single location. They include all other categories of pollution not classified as being from a point source, and are exempt from department permit regulations as per state rules at 10 CSR 20-6.010(1)(B)1. These sources usually involve stormwater runoff and are often minor or negligible under low-flow conditions. Nonpoint sources identified in the TMDL to have a potential to contribute bacteria loads in the Maline Creek watershed are onsite wastewater treatment systems and riparian corridor conditions.

4.2.1 – Onsite Wastewater Treatment Systems

When properly designed and maintained, onsite wastewater treatment systems (e.g., home septic systems) should not serve as a source of contamination to surface waters; however, onsite wastewater treatment systems do fail for a variety of reasons. Failing onsite wastewater treatment systems are known to be sources of bacteria, which can reach nearby streams through surface runoff and groundwater flows, thereby contributing bacteria loads under either wet or dry weather conditions. The TMDL estimates that there are potentially 284 parcels with onsite wastewater treatment systems in the Maline Creek watershed and that up to half of those may be failing. Since a properly functioning onsite system by design should not be contributing significant bacteria loads to streams in the watershed, no portion of the loading capacity is allocated to these sources. The load allocation assigned to onsite wastewater treatment systems is zero at all flows.

4.2.2 - Riparian Corridor Conditions

As part of its assessment of nonpoint sources, the TMDL presents an analysis of land coverage in the riparian corridors within the watershed. Riparian corridors are land areas adjacent to streams. The TMDL concludes that the riparian areas within the watershed are composed primarily of developed land coverages with greater than 20 percent imperviousness. Bacteria loading associated with runoff from such areas could contribute bacteria loads to the MS4 or directly to a stream. For purposes of the TMDL, bacterial contributions from riparian areas are incorporated into the MS4 wasteload allocation.

5 – Existing Loads and Needed Reductions

A water quality impairment occurs when existing pollutant loading to a water body exceeds that water body's assimilative capacity for that pollutant. In order to restore an impaired water body to conditions that meet water quality standards, current pollutant loading must be reduced. Reducing pollutant loading to the impaired streams from existing levels to levels equal to or less than the loading capacities calculated in the TMDL report will result in attainment of water quality standards. In order to estimate the amount of reduction that is needed, an estimate of existing loading must first be made.

Individually observed bacteria measurements collected during the recreational seasons of 2010 through 2012 were plotted on the TMDL load duration curve, as shown in Figure 6 in the TMDL report. Since the bacteria criterion for the protection of whole body contact recreation category B is expressed in Missouri's Water Quality Standards as a geometric mean, the loads calculated from individually observed measurements cannot be compared directly to the TMDL curve to estimate overall existing loading or needed reduction. Therefore, geometric means of the observed data within each specific flow range were calculated to make a comparison. The calculated geometric means presented in Tables 2 of this plan represents estimates of existing loading to Maline Creek. These estimates represent loading from both point and nonpoint sources in the watershed, as the available data is inadequate for estimating existing loading from specific sources. An estimation of the amount of load reduction needed at each flow condition to achieve the TMDL target can be estimated by calculating the difference of the estimated existing load from the loading capacity. Implementation actions that reduce loading during the flow conditions where the geometric mean of the observed data exceed the loading capacity will provide the greatest water quality benefit, but because the recreational use criterion is a

geometric mean, it may also be possible to meet water quality standards by reducing the frequency and magnitude of individual excursions above the loading capacity at any flow.

Additional water quality monitoring sites and sampling may help determine loading from a specific source or area in the watershed and help estimate the amount of reduction needed from that particular source. Such sampling may also be useful in determining critical areas where the greatest load reductions are needed and to determine how effective treatment technologies or BMPs are in achieving those reductions. Groups are encouraged to consult with the department's Water Quality Assessment and Monitoring Unit, available at 573-526-5297, for developing a monitoring component to any localized implementation or water quality improvement plans. Other department monitoring goals are specified within Section 12 of the TMDL report.

Table 2. Estimated load reductions for Maline Creek, WBID 1709[8]

Percent of time flow equaled or exceeded	***Flow m^3/s (ft^3/s)***	***TMDL (counts/day)***	***Existing Load (counts/day)***	***Reduction Needed (counts/day)***	***Reduction Needed (%)***
95	0.03 (0.97)	4.90E+09	2.92E+09	None	0
75	0.09 (3.33)	1.68E+10	2.80 E+10	1.12E+10	40
50	0.19 (6.58)	3.32E+10	6.63E+10	3.31E+10	50
25	0.41 (14.63)	7.37E+10	2.19E+11	1.45E+11	66
10	1.56 (54.93)	2.77E+11	2.47E+13	2.44E+13	99

6 – Implementation of the TMDL

TMDLs are not self-implementing and are not in and of themselves regulatory documents. Despite this, TMDLs provide a foundation for establishing water quality goals and determining appropriate actions and controls necessary for pollutant reductions. Progress towards meeting water quality standards in Maline Creek is expected to be long-term, and initial TMDL implementation will primarily be a continuation of already existing and planned activities.[9] Except in cases where activities and schedules are required by legally binding requirements, such as consent decrees or established permit conditions, an adaptive implementation approach that makes progress toward achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities should be used. The department will routinely examine available water quality data collected by other local, state and federal entities as part of its biennial assessment of water quality for Clean Water Act 305(b) and 303(d) reporting.

6.1 - Point Source Implementation

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require that permit conditions be consistent with the assumptions and requirements of TMDL wasteload allocations. How these conditions are expressed can vary depending upon the nature of the discharge. Although TMDLs are

[8] Estimates of existing loads and needed reduction are based on data available at the time of TMDL development. These estimates may be refined after the collection of additional data. The amount of overall loading and needed reductions are expected to decrease over time as implementation actions occur and progress is made to attain water quality standards.

[9] Some implementation activities predate the writing of this implementation plan. The Metropolitan St. Louis Sewer District's consent decree obligations began in 2012.

required to be written for daily time increments, permit effluent limits may be written in a form that derives from, and complies with, applicable water quality standards that use any time measure [40 CFR 122.44(d)(1)(vii)(A) and EPA 2006]. The department's permit writers have discretion for how TMDL wasteload allocations are considered in the permit and for determining appropriate schedules for implementation. Permit writers should consult available permit writing handbooks and technical support documents to determine appropriate limits.[10] Although wasteload allocations are often specified for individual facilities, in some cases it may be appropriate for pollutant loadings to be shifted between the individual wasteload allocations during NPDES permitting as long as the sum of the wasteload allocations remains unchanged and is not exceeded (EPA 2012). In no cases does a TMDL wasteload allocation allow for permit limits that exceed water quality standards. If water quality standard revisions result in criteria more stringent than an established TMDL wasteload allocation, then the more stringent criteria should be used in deriving the permit limits.[11] Information regarding the department's permitting process is available online at dnr.mo.gov/env/wpp/permits/index.html or by calling the department's Operating Permit Section at 573-522-4502. Point sources identified as potential contributors of bacteria in the Maline Creek watershed include discharges from MS4s, sanitary sewer overflows, and illegal straight pipe discharges.

6.1.1 – Municipal Separate Storm Sewer Systems (MS4s) discharges

Background: Two MS4 permits regulate stormwater discharges in the Maline Creek watershed. The Missouri Department of Transportation holds one of these MS4 permits and the Metropolitan St. Louis Sewer District along with its various co-permittees holds the other.

Objective: The Maline Creek *E. coli* TMDL uses an aggregated wasteload allocation to assign allowable pollutant loading for MS4 discharges. All MS4s must reduce pollutant loading to the maximum extent practicable, but for implementation planning and evaluation purposes, individual wasteload allocations may be estimated based on the proportion of each regulated entity's MS4 area within the watershed. Table 3 presents area information for making such estimates.

Strategy 1: MS4 permits require implementation of a comprehensive stormwater management program to minimize negative impacts to water quality and the aquatic ecosystem, to monitor and eliminate illicit discharges, and to provide long-term water quality protection. As required by the MS4 permits, a stormwater management plan must address six minimum control measures. These measures include public education and outreach, public involvement and participation, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention and general housekeeping for municipal operations. Continued implementation of these six minimum control measures is expected to aid in overall bacteria reductions as stormwater reductions are achieved; however, additional BMPs may be necessary to achieve the stated TMDL wasteload allocations specific to *E. coli*. Such additional BMPs may be those required by state operating permits or those specified in the Metropolitan St. Louis Sewer District's consent decree. It is likely that BMPs implemented to reduce stormwater

[10] The department maintains a Water Pollution Control Permit Manual to provide guidance to permit writing staff and is available online at dnr.mo.gov/env/wpp/permits/manual/. Additionally the EPA maintains a National Pollutant Discharge Elimination System, or NPDES, Permit Writers' Manual online at www.epa.gov/npdes/npdes-permit-writers-manual and other technical support documents for water quality-based permitting at cfpub.epa.gov/npdes/docs.cfm?program_id=2&view=allprog&sort=name.

[11] Federal regulations at 40 CFR 131.21, also known as the "Alaska Rule," require water quality standards to be approved by EPA before they can be used for Clean Water Act purposes (i.e., water quality-based effluent limitations or TMDLs).

inputs into the separate sanitary sewer system that result in reductions in sanitary sewer overflows will help to reduce bacteria loading from the MS4s. Additional information regarding MS4 permit requirements can be found in Missouri's Stormwater Clearinghouse online at dnr.mo.gov/env/wpp/stormwater/sw-local-gov-programs.htm.

Table 3. Proportions of MS4 area for permittees in the Maline Creek watershed

MS4 Permittee	***MS4 Area km²(mi²)***	***MS4 area %***
Bel-Nor	0.28 (0.11)	0.43
Bel-Ridge	1.76 (0.68)	2.66
Bellefontaine Neighbors	8.08 (3.12)	12.23
Berkeley	4.40 (1.70)	6.66
Black Jack	1.53 (0.59)	2.31
Calverton Park	0.44 (0.17)	0.66
Charlack	1.71 (0.66)	2.59
Cool Valley	0.98 (0.38)	1.49
Dellwood	2.67 (1.03)	4.04
Ferguson	15.57 (6.01)	23.55
Florissant	0.44 (0.17)	0.66
Hazelwood	0.08 (0.03)	0.12
Jennings	3.29 (1.27)	4.98
MoDOT	3.60 (1.39)	5.45
Moline Acres	1.37 (0.53)	2.08
Normandy	1.68 (0.65)	2.55
Overland	0.10 (0.04)	0.16
Riverview	1.17 (0.45)	1.76
St. John	2.12 (0.82)	3.21
St. Louis County	14.81 (5.72)	22.41
TOTAL:	66.08 (25.52)	100.00

The Metropolitan St. Louis Sewer District has posted the MS4 stormwater management plan on their website at stlmsd.com. Summaries of BMPs for reducing urban stormwater and pollutants in stormwater are also presented on their website. Some examples of structural BMPs mentioned include rain gardens, rain barrels, and detention basins to capture stormwater, as well as overall reductions of impervious surfaces. Nonstructural BMPs, such as picking up pet wastes and maintaining longer lawns, are also mentioned. The purpose of these practices is to reduce the volume of stormwater runoff from the MS4 area that directly enters streams and, consequently, reduce the potential for erosion resulting from runoff conditions. This reduction in overall runoff and erosion is expected to reduce bacteria loading during storm events. The Missouri Department of Transportation also makes their MS4 stormwater management plan available online at modot.org/stormwater. In addition to stormwater runoff reductions, the Department of Transportation plan provides information regarding BMPs associated with erosion control and sediment containment, which can reduce the likelihood of bacteria contaminated sediments from entering a stream via runoff. Additionally, the plan includes goals of restoring and revegetating riparian areas that the agency's activities may have disturbed. Although these activities do not

target *E. coli* directly, reductions in runoff and sediment entering Maline Creek is expected to reduce bacteria loading.

Strategy 2: General reductions in stormwater are expected to aid in overall pollutant reductions, but BMPs specifically designed to address the pollutant of concern should be considered. Although few BMPs are specifically designed to address bacteria directly, the International Stormwater BMP Database, available online at bmpdatabase.org, provides information about various BMP efficiencies for reducing specific pollutants including bacteria. BMPs found to show a statistically significant decrease of bacteria include bioretention BMPs, retention ponds, and wetland basins (Table 4).

Table 4. Influent/Effluent Summary for BMPs with a statistically significant decrease in *E. coli*

BMP Type	***# of Studies***		***25th Percentile (count/100mL)***		***Median (count/100mL)***		***75th Percentile (count/100mL)***	
	In	***Out***	***In***	***Out***	***In***	***Out***	***In***	***Out***
Bioretention	4	4	44	6	290	101	2,400	2,400
Retention Ponds	4	4	582	10	2,063	100	5,500	697
Wetland Basin	5	5	383	88	1,369	637	7,169	2,376
Retention Pond + Wetland Basin	9	9	403	36	1,713	311	6,100	1,300

(Source: bmpdatabase.org 2014)

6.1.2 – Sanitary Sewer Overflows

Background: Accidental and constructed sanitary sewer overflows were identified as potential point source contributors of bacteria to Maline Creek. The Clean Water Act does not authorize discharges from sanitary sewer overflows.

Objective: Occurrences of accidental discharges should be reduced as much as possible and should be rare in occurrence. Constructed overflows are to be eliminated altogether. The TMDL does not allocate any portion of the loading capacity to sanitary sewer overflows and assigns a wasteload allocation of zero to these sources.

Strategy 1: The Metropolitan St. Louis Sewer District's consent decree requires the elimination of all constructed sanitary sewer overflows in the Metropolitan St. Louis Sewer District's service area. The complete elimination of constructed sanitary sewer overflows from the Maline Creek watershed will be consistent with the TMDL wasteload allocation of zero for these discharges. This represents a 100 percent reduction of bacteria loading from these sources.

Strategy 2: Sanitary sewer overflows caused by malfunctions or stormwater inflows could occur in any area where a sanitary sewer system is present. Facilities with sanitary sewer overflows must implement, as a condition of their operating permit, a Capacity, Management, Operation and Maintenance Plan, which is more frequently referred to as a CMOM. The EPA provides CMOM guidance at www3.epa.gov/npdes/pubs/cmom_guide_for_collection_systems.pdf. Common implementation activities for reducing sanitary sewer overflows include pipe cleaning to reduce blockages; pipe lining or replacement to reduce inflow and infiltration of outside water; public education to reducing the input of sewer clogging fats, oils and grease; and, in some cases,

increases to the sewer system's hydraulic capacity are made by enlarging pipes or by constructing storage tanks.

The Metropolitan St. Louis Sewer District's consent decree includes the goal to eliminate these types of overflows and requires various repair and maintenance strategies to reduce occurrences of sanitary sewer overflows. Examples of such strategies mentioned in the consent decree include sewer-pipe lining and replacement, development of an operations and maintenance program, and continued implementation of a fats, oils, and grease program. These consent decree actions to reduce sanitary sewer overflows are consistent with the actions necessary for TMDL implementation and are expected to result in reductions of bacteria loading. It is estimated that over its entire service area, controls already implemented by the Metropolitan St. Louis Sewer District, as well as those completed as part of its consent decree obligations, will reduce overflows into nearby streams by almost 13 billion gallons per year (EPA 2015).

6.1.3 – Illicit (Illegal) Straight Pipe Dischargers

Background: These types of sewage discharges bypass treatment systems, such as a septic tank or a sanitary sewer, and instead discharge directly to a stream or an adjacent land area. Straight-pipe discharges are illegal and are not permitted under the Clean Water Act.

Objective: Due to the illegal nature of these types of discharges, straight-pipe discharges are not assigned a portion of the overall loading capacity. The complete elimination of these sources is consistent with the TMDL wasteload allocation of zero.

Strategy: The detection and elimination of illicit discharges is a required permit condition for MS4s. Therefore, implementation efforts to reduce loading from these sources in the Maline Creek watershed will be completed as part of the required six minimum control measures.

6.2 - Nonpoint Source Implementation

The department does not regulate nonpoint sources through permits. Nonpoint source loading is reduced using voluntary BMPs that can be implemented to address and improve land use practices that may be contributing bacteria to the impaired water bodies. Nonpoint source load reductions can be achieved from individual actions and BMP implementation from any place throughout the watershed, but may be more substantial and effective in restoring water quality when targeted and organized by locally led watershed groups or local governments who have developed a watershed-based management plan. The department supports the development of nonpoint source watershed management based plans through competitive EPA funded subgrants. More information about the department's Section 319 Nonpoint Source Implementation Program is available online at dnr.mo.gov/env/wpp/nps/index.html or by calling 573-751-7428. The University of Missouri Extension also provides guidance and support for communities and citizens to develop organized watershed groups. Information regarding this program is available online at fsb.missouri.edu/extension/waterquality/.

Nonpoint sources primarily contribute bacteria loads at flows influenced by precipitation events through contaminated stormwater runoff and the erosion of bacteria contaminated sediments. For this reason, BMPs that reduce runoff and erosion will be the primary means of achieving load reductions from nonpoint sources to meet the target load allocation. However, failing onsite wastewater treatment systems and direct waste inputs from animals that are not excluded from

waterways can contribute bacteria loads under dry conditions as well. Therefore, BMPs that reduce nonpoint source loading at lower flows may also help to attain water quality standards. Onsite wastewater treatment systems were identified as nonpoint sources in the Maline Creek watershed.

6.2.1 – Onsite Wastewater Treatment Systems

Background: Failing onsite wastewater treatment systems may be sources of bacteria to nearby waterways during periods associated with either wet weather or dry weather flows depending upon the nature of the failure. Proper maintenance of onsite wastewater treatment systems, including septic tanks, associated drain fields, and household lagoons is the primary BMP for limiting bacterial inputs from these sources.

Objective: By design, properly functioning onsite wastewater treatment systems should not be contributing significant bacteria loads to surface waters. For this reason, the TMDL assigns a load allocation of zero to these potential sources.

Strategy 1: Educate homeowners about proper onsite wastewater treatment system maintenance. This may be provided by local governments, local watershed groups, or by university extension offices. The EPA maintains various guidance documents and resources pertaining to onsite treatment systems online at water.epa.gov/infrastructure/septic/homeowner-resources.cfm including a "Homeowner's Guide to Septic Systems." Similarly, the East-West Gateway Council of Governments has developed a septic system maintenance guide for the Lower Meramec Watershed. Although not developed specifically for the region where Maline Creek is located, the guide, available online at ewgateway.org/pdffiles/library/wrc/septictankbrochure.pdf, does provide useful septic system information that is relevant throughout St. Louis County. For onsite wastewater treatment systems that are already failing, repairs or even replacement of the system are necessary.

Strategy 2: Local ordinances must be followed regarding permitting requirements pertaining to repairs, replacement or the installation of new systems. Where feasible, enforcement of local ordinances requiring a sewer connection if a sewer system is within 200 feet of a home will also aid in reducing bacteria loading in the Maline Creek watershed.

Strategy 3: Considerations should also be given to reducing reliance on onsite systems in favor of centralized systems. Homeowners and local governments should explore the potential elimination of onsite systems and connection to existing sewer systems.

7 – Costs of Implementation and Potential Funding Sources

TMDLs are written to meet applicable water quality standards per 40 CFR 130.7(c)(1), and this is done absent of considerations for cost and available treatment technologies. Despite this, facility upgrades and installations of BMPs do have costs associated with them that need to be considered before determining what practices and technologies to employ in order to meet the specified TMDL allocations and water quality targets. For point sources, TMDL implementation is partially a continuation of already permitted activities and some costs will be incurred as part of the normal operation and maintenance of those permitted systems. Additional costs will primarily result from activities and projects associated with meeting the obligations of the Metropolitan St. Louis Sewer District's consent decree. According to this consent decree, the

district has already spent $2.1 billion over the past twenty years in upgrading its sewer systems. The total cost of compliance with the consent decree, in 2011 dollars, is estimated to be $4.7 billion (MSD 2014). For nonpoint sources, there may be costs associated with the voluntary implementation of BMPs to reduce erosion and control stormwater runoff, as well as from the maintenance or repair of onsite wastewater treatment systems. These costs are variable and dependent upon the type, number, and complexity of the practice. Fortunately, a single BMP can often be utilized to address several pollutants, thereby providing additional benefits to compensate for overall costs. One online resource that provides estimates of BMP efficiencies as well as costs is the International Stormwater BMP Database at bmpdatabase.org.

Due to the costs associated with pollutant reduction and water quality improvement, a variety of grants and loan programs have been established to assist watershed stakeholders. The most commonly used sources of funding are low-interest loans through the State Revolving Fund, Section 319 subgrants, and cost-share practices through the state's Soil and Water Conservation Program.

Low-interest loans from the State Revolving Fund program through the department's Water Protection Program Financial Assistance Center may be available. The State Revolving Fund provides low-interest loans to municipalities, counties, public sewer districts and political subdivisions for wastewater infrastructure projects. Projects may be new construction or the improvement or renovation of existing facilities. An onsite loan program to provide county or municipal governments with funding for addressing onsite wastewater treatment systems is currently under development. More information regarding the State Revolving Fund Program is available online from the department's Water Protection Program Financial Assistance Center website at dnr.mo.gov/env/wpp/srf/index.html.

By amendment to the federal Clean Water Act in 1987, the Section 319 grant program was established to provide funding for efforts to reduce nonpoint source pollution. EPA provides 319 funding to the state, which in turn allocates a portion of the funding as subgrants to public and non-profit organizations to address nonpoint source concerns. Section 319 funded subgrants may be used to demonstrate innovative best management practices, support education and outreach programs, restore impaired waters, or protect waters from becoming impaired. In some cases, nonpoint sources for Section 319 purposes may differ from those outlined in the TMDL. For example, urban runoff regulated by an MS4 permit is considered a point source, but in some instances can be considered a nonpoint source for Section 319 purposes. More information regarding the Section 319 Nonpoint Source Implementation Program is available online at dnr.mo.gov/env/wpp/nps/index.html.

The department's Soil and Water Conservation Program provides financial incentives to landowners to implement practices that help to prevent soil erosion and protect water quality. The program offers cost-share programs through its county conservation districts. Landowners can receive up to 75 percent reimbursement of the estimated cost of a practice through the program. The primary funding for cost-share practices from the Soil and Water Conservation Program comes from the one-tenth-of-one percent parks, soils and waters sales tax. More information regarding the Soil and Water Conservation Program and cost-share practices is available online at dnr.mo.gov/env/swcp/service/swcp_cs.htm.

In addition to these state sources of funding, federal assistance, public bonds and private financing may also be sources of available funding. The EPA maintains the Catalog of Federal Funding Sources for Watershed Protection, which is a searchable database of financial assistance sources. The link to this online catalog as well as other federal funding sources is provided in Table 5.

Table 5. Online resources for potential funding sources

Name & URL	***Description***
Catalog of Federal Funding Sources for Watershed Protection https://ofmpub.epa.gov/apex/watershedfunding/f?p=fedfund:1	Searchable data of financial assistance sources for watershed protection
Nonpoint Source – Related Funding Opportunities http://water.epa.gov/polwaste/nps/funding.cfm	List of federal websites with information regarding funding opportunities
Water: Grants & Funding http://water.epa.gov/grants_funding/	EPA website providing information about available grants
Watershed Funding http://water.epa.gov/aboutow/owow/funding.cfm	Funding resources and tools from EPA
Environmental Education Grants http://www2.epa.gov/education/environmental-education-ee-grants	Financial support for environmental education projects
Targeted Watershed Grants Program http://water.epa.gov/grants_funding/twg/initiative_index.cfm	EPA grant to increase citizen stewardship of urban waterways
Environmental Justice Grants http://www3.epa.gov/environmentaljustice/grants/	Grant resources for Environmental Justice communities
Center for Environmental Finance http://www2.epa.gov/envirofinance	Provides direction and leadership for developing innovative financing methods
Grants.gov http://www.grants.gov	A common website for federal agencies to post funding opportunities

8 – Measurable Goals, Timeline and Milestones

TMDL implementation uses an adaptive management process that makes progress toward achieving water quality goals while using any new information to reduce uncertainty and adjust implementation activities. Timelines and interim milestones for reaching this goal will vary depending upon the means of implementation, as well as the strategies used to address individual point or nonpoint sources. As part of the iterative and adaptive approach, timelines may be adjusted as additional information becomes available and implementation strategies are refined. For this reason, progress toward meeting water quality standards in the Deer Creek watershed is expected to be a long-term process and partially a continuation of current, ongoing or legally required activities, as well as any voluntary measures that may be planned or in place. Many of the necessary implementation activities will be the result of projects completed to meet the Metropolitan St. Louis Sewer District's consent decree and long-term control plan. The schedules established by these legal requirements will act as the primary timeline for TMDL implementation. Additional goals and milestones established in stormwater management plans

for meeting MS4 permit requirements and those included in the nonpoint source watershed management plan should also be considered.

The consent decree also requires the elimination of all constructed sanitary sewer overflows in the Metropolitan St. Louis Sewer District's service area and provides a specific timeline for such eliminations. In accordance with the consent decree, constructed sanitary sewer overflows will be scheduled for elimination by no later than 2033 with 85 percent of the overflow outfalls to be eliminated by 2023. The order of the eliminations will be based on the potential for human health and environmental risks, frequency of overflow, estimated volumes, and technical engineering judgment. A schedule for the elimination of all constructed sanitary sewer overflows in the Maline Creek watershed is presented in Table 6. A map showing the locations of constructed sanitary sewer overflows in the watershed can be found in Figure 5 of the TMDL document.

Table 6. Elimination dates of constructed sanitary sewer overflows

Name	***Street No.***	***Street Name***	***Removal Date[12]***
BP-281	413	Averill Avenue	2018
BP-287	10063	Coburgh Lands Drive	2023
BP-289	9600	Colony Drive	2023
BP-291	75	Floridale Court	2023
BP-292	7669	Florissant Road	2023
BP-295	1032	Forestwood Drive	2018
BP-296	201	Forestwood Drive	2018
BP-305	701	Marvin Drive	2018
BP-313	1904	Prior	2023
BP-316	818	Robert Avenue	2018
BP-317	729	Science Hill	2033
BP-322	820	Thatcher Avenue	2018
BP-597	4429	Rolling Drive	2023

MS4 stormwater management plans available at the time of this writing were developed prior to the approval of the Maline Creek *E. coli* TMDL. Following TMDL approval, it is expected that these stormwater plans will be revised as appropriate to incorporate the goals of both the TMDL and this implementation plan. Both the Metropolitan St. Louis Sewer District and the Department of Transportation have developed stormwater management plans that are available online. The plans are available on the respective organizations' websites at stlmsd.com/what-we-do/stormwater-management/phase-ii-stormwater-management-plan and modot.org/stormwater/. A detailed schedule pertaining to BMP implementation, illicit discharge detection, education, construction site runoff control, post-construction stormwater management, and pollution prevention is given in the Metropolitan St. Louis Sewer District's plan.[13] The Department of Transportation plan is written to cover activities statewide, so it is more general in nature and does not contain a detailed schedule. However, it does note specific measurable goals associated with the implementation of various BMPs.

[12] The removal date indicates the date after which EPA can assess penalties.

[13] See Chapter 11 of the stormwater management plan.

9 – Conclusion

The purpose of this TMDL implementation plan is to serve as a guide to department staff, Soil and Water Conservation districts, local governments, permitted entities, watershed managers, and citizen groups for reducing existing bacteria loads in order to meet the loading targets established in the Maline Creek *E. coli* TMDL. The ultimate goal is to restore the bacteria impaired streams in the Gravois Creek watershed to conditions that meet water quality standards using and adaptive implementation approach that makes progress toward achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities. Implementation efforts are expected to be long-term, occurring over a number of years, but also within the schedules established in stormwater management plans, Section 319 watershed-based plans, state operating permits, and the Metropolitan St. Louis Sewer District's consent decree. Success in achieving water quality standards will be determined by the department through biennial assessments of water quality compliance as required by Sections 305(b) and 303(d) of the Clean Water Act.

An administrative record for the Maline Creek *E. coli* TMDL has been assembled and is on file with the Department of Natural Resources. The administrative record includes this implementation plan, the TMDL, and any studies, data and calculations on which the TMDL is based. This information is available upon request to the department at dnr.mo.gov/sunshine-form.htm. Any request for information will be processed in accordance with Missouri's Sunshine Law (Chapter 610, RSMO) and the department's administrative policies and procedures governing Sunshine Law requests. For more information about open record/Sunshine requests, please consult the department's website at dnr.mo.gov/sunshinerequests.htm.

This implementation plan is scheduled for a 60-day public notice and comment period in conjunction with the comment period for the Maline Creek *E. coli* TMDL. Any comments received and the department's responses to those comments are maintained on file with the department and are posted online at http://dnr.mo.gov/env/wpp/tmdl/1709-3839-maline-cr-record.htm. The department maintains an email distribution list via GovDelivery.com for notifying subscribers regarding significant TMDL updates or activities. Those interested in subscribing to these TMDL updates may do so by submitting their email address at public.govdelivery.com/accounts/MODNR/subscriber/new?topic_id=MODNR_177.

10 – References

Brown, E., Caraco, D. and R. Pitt. 2004. Illicit Discharge Detection and Elimination a Guidance Manual for Program Development and Technical Assessments. EPA X-82907801-0

EPA (U.S. Environmental Protection Agency). 1997. Volunteer Stream Monitoring: A Methods Manual. EPA 841-B-97-003

EPA (U.S. Environmental Protection Agency). 2015. St. Louis Clean Water Act Settlement Webpage. [Online WWW] Available URL: http://www2.epa.gov/enforcement/st-louis-clean-water-act-settlement [Accessed Nov. 17, 2015].

MSD (Metropolitan St. Louis Sewer District). 2014. Sanitary Sewer Overflow Control Master Plan Revised – Aug. 29, 2014.

Maline Creek downstream of Bellefontaine Road
(Upper Left – low flow conditions in 2006. Lower Right – stormwater conditions in 2015)